CHAPTER 4

BOAT RAMPS

4-1. Introduction. This chapter deals with the design of ramps used for launching boats from trailers. Appurtenant structures, such as docks, mechanical boat launching areas and marinas are not covered here. The number of ramps and lanes and the general location should be determined and set out in planning reports.

4-2. Application. Boat launching ramps are needed for access to water bodies for pleasure boating, fishing, water skiing, sailing, hunting, scuba diving, underwater exploration, operation, maintenance and water patrol personnel. Ramps serve various needs such as the small fisherman's 'Johnboat' in a remote part of the water body to large luxury cabin cruisers and hydro racing craft.

4-3. Controls. Characteristics of boat, trailer, and vehicle; extent, duration, and frequency of water level fluctuations; current velocities, waves, and prop wash control the design of boat ramps. Lake and river topography above and below the water surface; planform, type, and layering of soils and rock; and flood flows are critical considerations which must be addressed in developing proper boat ramp design. Also, many drainage areas are locations of landslides or geologically recent and transitory land forms which are quite susceptible to failure and erosion processes. Safety in launching and retrieving the boat and providing for the handicapped also control boat ramp design.

4-4. Design Considerations.

a. Characteristics of Boat, Trailer and Vehicle.

(1) Boat. Data on types and sizes of various boats are given in American Institute of Architects, "Architectural Graphic Standards", dated 1971.

(2) Boat trailer. The greatest weight of the loaded boat trailer is assumed to be 9600 pounds for a craft 28 feet long. This weight is the assumed maximum for ramp design. The total weight of some vehicles using the ramp might equal or exceed the above maximum. Generally, however, this should not influence the design of the ramp since most ramp surfacing must withstand heavy wave action.

(3) Vehicle. The vehicles which carry boats or tow boat trailers limit the steepness of grade of the launching ramp because of their power, traction and braking ability. Their turning radii place limitations on layout for maneuverability. Their traction requires a

rough ramp finish because mud and slime tend to accumulate on surfaces. Their underside clearance limits affect permissible break over angles of grade profiles. Ramps should be steep enough in grade to permit the vehicle to back far enough down the ramp to permit launching without submerging exhaust pipe ends or rear wheel bearings and brakes.

b. Topography and Physical Conditions.

(1) Fluctuation of water level. Precipitation and operations result in water level fluctuations at Corps projects. These fluctuations are set out in lock and dam operation and reservoir regulation plans. Wetter or dryer than normal years may result in variations from the normal reservoir regulation and should also be considered when designing boat ramps.

(2) During the planning phase general locations for boat ramps should be determined. Bank or shore area excavation should slope toward the water at grades which will conform, as much as feasible, to ramp grades thus avoiding excessive cuts or fills and thus fit in smoothly with the surroundings. There should be sufficient area at gentle grade near the top of ramp for turning and parking. The ramp site should be easily accessible. Sites where construction scars would adversely affect views from the water should be avoided.

c. Soil Stability. Care should be taken in siting ramps so that there is no unaddressed significant risks from landslides, rockfalls or bank failures. Site specific sampling, testing, and analysis to determine conditions at each ramp site should be conducted to verify location suitability. Fluctuations in river and lake levels, seepage conditions, and effects of excavation and fill placement and construction of structures should be evaluated.

4-5. Geometric Design.

a. Access. The approach to the ramp from both the main access road and the parking facility seems to work best by means of a one way circulation system. There have been instances where unoriented visitors have mistakenly driven down a ramp thinking that it was an extension of the road. Therefore, the circulation road should have an alignment that requires a definite turn at or just prior to its intersection with the ramp (See Figures 4-1 and 4-2).

b. Parking. Parking facilities for vehicles pulling trailers at boat ramps should be pull through type parking. The spaces should be 10 feet wide by 42 feet long. The angle of the parking may vary to suit existing conditions but it should be remembered that all inside turning radii should be a minimum of 15 feet.

c. Length and Width. The optimum length and width of a ramp will vary depending upon the physical conditions of a given site.

(1) The width may vary as follows:

Ramp Length	Lane Width
Under 50 feet	12 feet
50 feet to 75 feet	14 feet
over 75 feet	16 feet

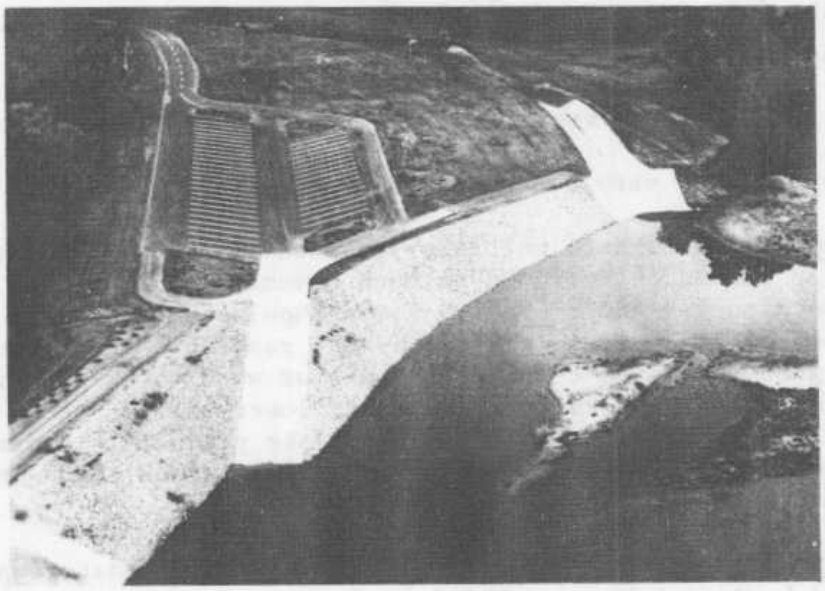


Figure 4-1 Access, Circulation, and Parking at a Boat Ramp

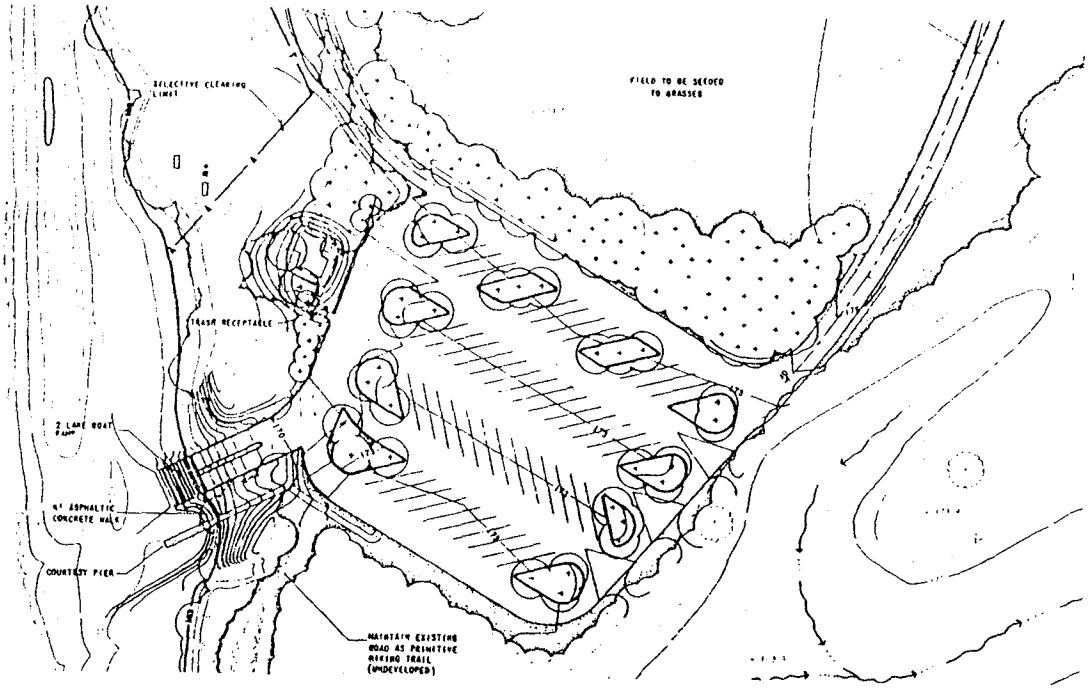


Figure 4-2 Access, Circulation, and Parking at a Boat Ramp

(2) The length will vary depending on pool elevation and ramp grade.

(a) Pool elevation. Where multiple-lane concrete ramps are needed, one or more lanes should be designed to meet demands for launching at low pool levels. Both public and operation needs should be met. Ramp length for various types of lakes is determined by the reservoir regulation plan. The designer should be completely familiar with the regulation plan prior to designing boat ramps. Upper and lower limits are to be established for each ramp designed for use at lake projects. Ramps serving launching into streams or rivers should meet annual high and low water flow conditions.

1. Upper limit. The upper limit to be considered in boat ramp design for Flood Control Lakes and Multiple Purpose Lakes is the 5-year frequency flood pool elevation. This elevation is stated in feet above mean sea level. The upper limit for Navigation Lakes is 3 feet above the normal operating pool. Appropriate allowance should be made for backwater effects.

2. Lower limit. The lower limit water elevation to be considered for design of boat ramps at the various types of lakes are:

(a) Flood control lakes. A minimum of four feet below the permanent pool.

(b) Multiple-purpose lakes. Four feet below the 10 year drawdown.

(c) Navigation lakes. A minimum of four feet below the normal operating pool.

(b) Grade.

1. Ramp grades should be a minimum of 12 percent and maximum of 16 percent. Grades of 14 percent are preferable. A straight line grade from top to bottom is not necessary when changes in grade will better fit the terrain. Care should be taken when changing the grade to assure that vehicles and trailers will not drag the surface at the break over points. This is particularly important at the top of ramps where the access pavement meets the ramp. The break over angle at the point of beginning of the ramp or at any other change of ramp grade, should not exceed 7 degrees. When conditions require an angle greater than 7 degrees a vertical curve should be used to prevent dragging of the surface. Transverse grade should be flat for ease of construction. (See Figure 4-3). When there are requirements for ramps at locations with existing terrain having a grade less than 12 percent a combination of ramps, boat channels, and boat turning basins, may be used if siltation is not a problem.

2. Each ramp should have a minimum of one 75-foot diameter vehicular turnaround or equivalent supplemented with additional turnarounds at a 150 foot interval on a continuously sloping ramp. Vehicular turnarounds may overlap for multiple ramps. Turnarounds should permit vehicles to drive head first down the ramp, turn around and back the trailers into the water for boat launching. An additional access level (road, not a turnaround) should be provided for dangerously long ramps (300 feet or more). The additional access road should be provided at the mid point of the ramp.

d. Shoulders. Ramp shoulders should be stabilized with rock to prevent erosion and to provide support to errant vehicle wheels going off the pavement. Either graded riprap or quarry run rock may be used for this purpose. Rock should be sized for the anticipated wave action or current as the case may be using customary Corps of Engineers criteria. To prevent trailer wheels from dropping into holes in the rock or people from stepping into them and incurring injury, the surface of the rock should be chocked and grouted as necessary. Grouting also prevents loss of rock due to vandalism and theft. Chocking and grouting both reduce the effectiveness of the riprap shoulder protection by interfering with dissipation of wave energy in the interstices of the rock. For this reason the rock size should be increased over the size that would be used otherwise. The thickness of quarry run rock should be increased similarly. The "Typical Transverse Section" on Figure 4-3 shows a detail for rock protection of a ramp without curbs. Figure 4-4 shows details for rock protection of ramps with curbs.

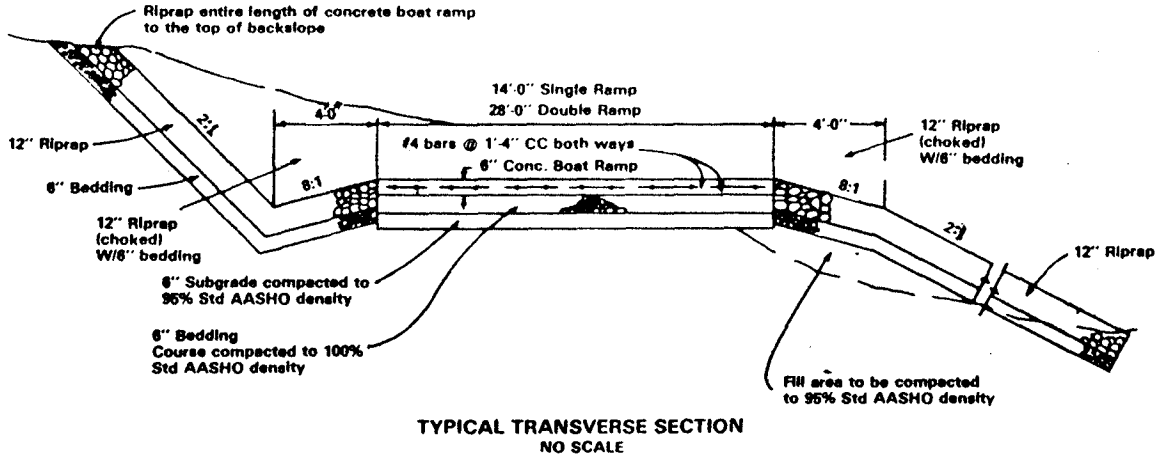


Figure 4-3 Rock protection details for boat ramp without curbs

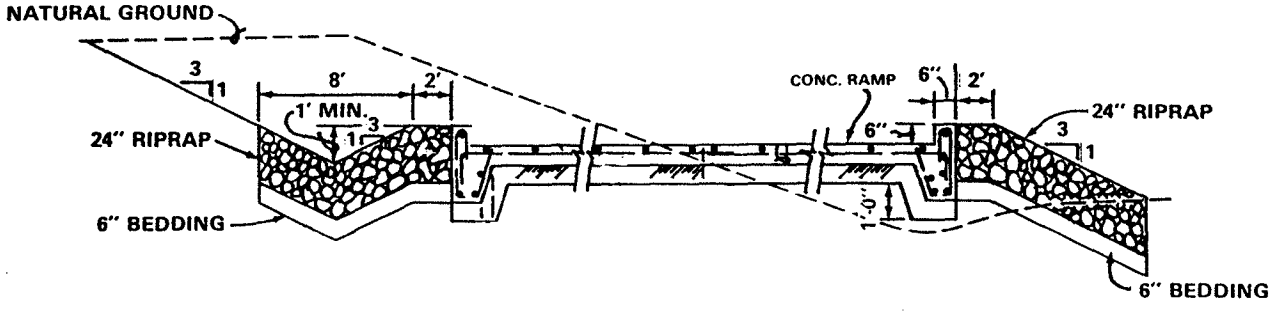


Figure 4-4 Rock protection details for boat ramp with curbs

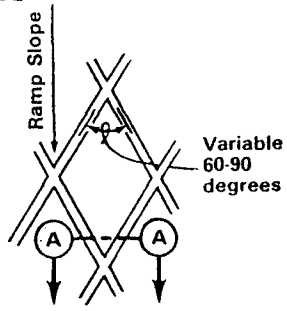
e. Curbs. Single lane ramps should be designed with curbing to provide a margin of safety to drivers inexperienced in backing vehicles with trailers. Curbs integral to pavement are preferred.

f. Surface. Permanent ramps should be surfaced with reinforced or prestressed concrete. Ramps should have a minimum concrete thickness of 6 inches, a 6 inch bedding course compacted to 100 percent density, and a subgrade compacted to 95 percent density. The surface should be grooved in a herringbone pattern, down sloped from the center of the ramp to the outside edge. Figure 4-5 shows surface finish for concrete ramps. Asphaltic concrete has been a troublesome surface for ramps because of the slick, caused by algae, that can form just above and below the water surface and sediments deposited on the ramp on the water side.

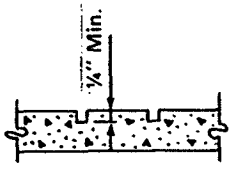
4-6. Drainage and Erosion Control. Surface runoff should be directed away from ramps at intervals which will eliminate erosion of ramp shoulders or carry debris onto the ramp. Particular attention should be given to turning the runoff in roadside ditches of ramp access roads away from the ramp. Interceptor and diversion ditches and dikes or levees may be used where needed for protecting boat ramps from erosion by surface runoff. Riprap is also used to protect the ramp from erosion by wave attack. Boat launching ramps can easily be damaged by erosion. When it is necessary to locate ramps where they are exposed to heavy wave action, breakwaters should be included in the design for erosion control and to make launching and recovery safer and easier. The effect of breakwaters on siltation must be considered when breakwaters are made a part of the design of the boat ramp. Ramps constructed where relatively high stream velocities are anticipated, such as on river navigation projects, can be constructed on rockfills above the existing grade in order to avoid future undercutting and siltation. Weep holes should be provided for draining the subgrade of ramps constructed on soil subgrades that are without a free draining base.

4-7. Markers and Signs. A suitibly sized sign with launching and retrieval instructions should be provided. Directional signs should be used to direct traffic to and from ramps and parking areas. Warning signs should be used as appropriate. Directional pavement markings may be used as needed to indicate traffic flow and movements. These markers and signs should conform with the latest ANSI standards. The water areas, turning basins and channels related to the launching of boats should be marked according to standard navigation markings.

4-8. Landscaping. Good sight distance should be maintained in the immediate vicinity of the ramp particularly the access and the upper turnaround areas. The zone where vehicles leave the ramp to proceed to the parking area should also be maintained for good visibility. Grasses and low growing shrubs (3 feet at maturity) should be used in the vicinity of the ramp where visibility should be maintained.

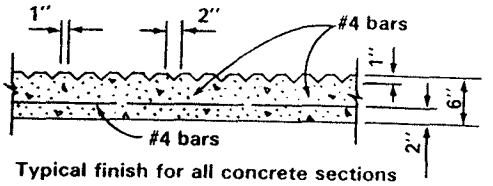


PLAN



SECTION A-A

ALTERNATE SURFACE FINISH DETAIL
NOT TO SCALE



Typical finish for all concrete sections

Note:

The ramp surface shall be finished by Jitterbugging (vibrating a steel mesh into the ramp surface.) The tool shall be designed to leave a pattern in the ramp surface as indicated in Surface Finish Detail. When the tool is removed from the surface the resulting finish shall be a dense, rough surface. The space between parallel grooves of surface finish shall be not less than 2" nor more than 3".

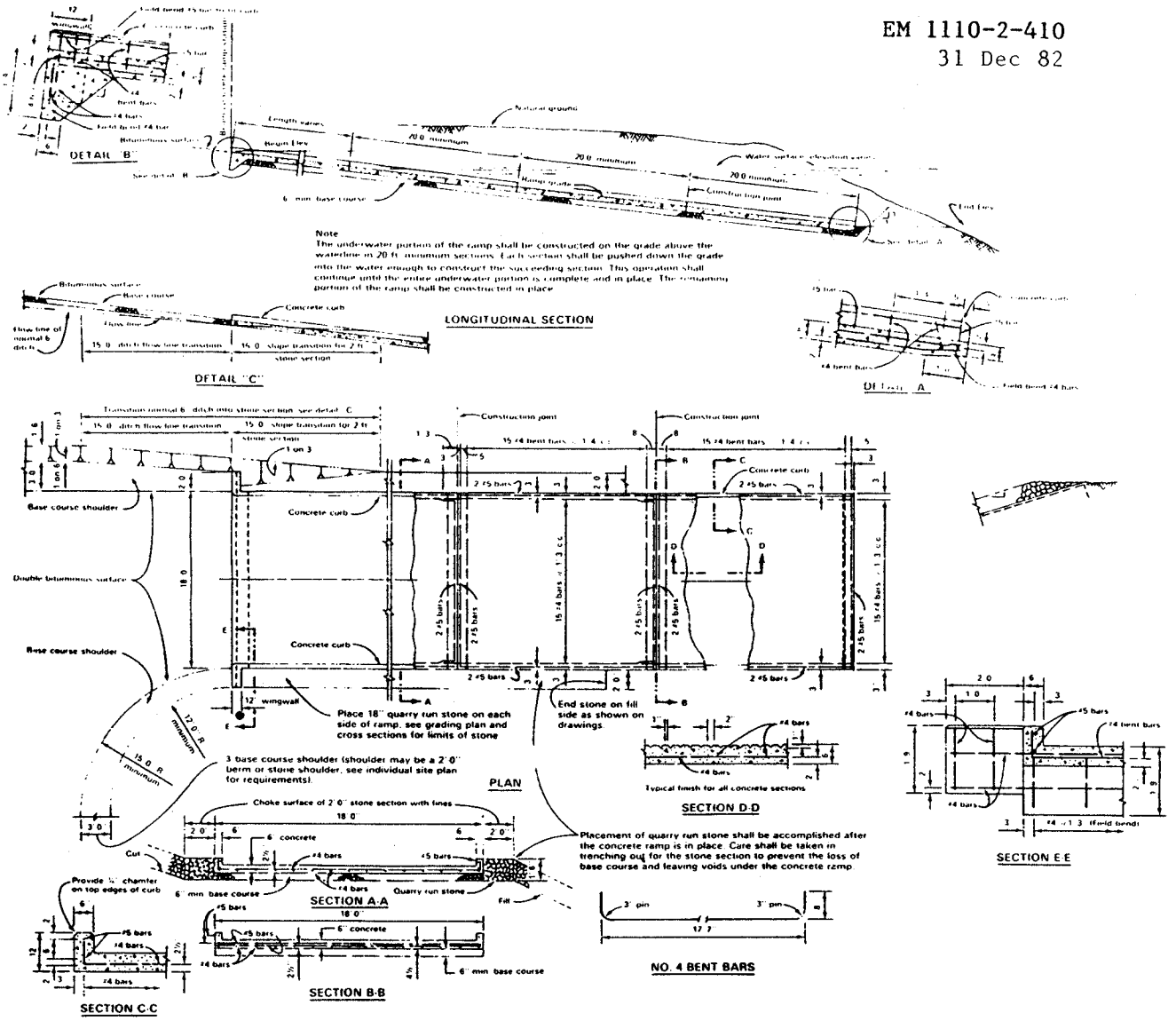
Figure 4-5 Concrete surface finish for boat launching ramp

4-9. Lighting. High pressure sodium lighting on wooden poles should be used for night lighting of boat ramps. Lighting level should be one candle power over one lane, turn-around and tie-down area.

4-10. Temporary Ramps. These may be constructed when the situation warrants until permanent ramps can be constructed. Temporary ramps should be of expedient design and conform to the foregoing standards of this chapter as nearly as is reasonable except grade when stone and gravel or other loose material is used that could impair traction of the vehicle. Grades should be reduced to 11 percent. Suitable materials are steel mats, crushed stone and gravel or earth materials stabilized by additives. Precast concrete planks or other suitable bearing material should be used for extending existing ramps during periods of extreme drawdown elevations.

4-11. Ramps For Existing Impoundments. Where additional ramps are required for existing impoundments and it is not feasible or economical to permit construction in the dry, ramps may be constructed on the bank and shoved into the water on a temporary base course. Figure 4-6 shows details for such a ramp with side curbs.

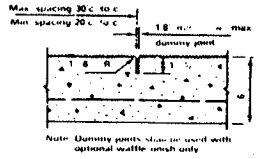
4-12. Plank Ramps. Precast reinforced or prestressed concrete plank ramps may be used for permanent boat launching ramps in areas where they are sheltered from wave or current attack. They also may be used to extend existing ramps during periods of extreme drawdown.



DATA FOR CONSTRUCTION OF CONCRETE LAUNCHING RAMP

SITE LOCATION FOR RAMP	PERCENT OF GRADE	BEGIN RAMP STATION	BEGIN RAMP ELEVATION	END RAMP ELEVATION	TOTAL ACTUAL LENGTH OF RAMP
Toad Suck Ferry West	14.0%	1 07 37	274.0	249.0	206 87
Dam Site 9 North	14.0%	1 98 14	290.0	261.0	206 87

NOTES:
1. The top surfaces of the ramps may be given a waffle grid finish at the contractor's option in lieu of the grooved finish shown on the plan, see specifications. Where a waffle finish is used, transverse dummy joints shall be applied as shown by the joint detail, this drawing.
2. The concrete in each section to be pushed shall be cast on heavy building paper, roofing felt or other approved material to facilitate sliding.
3. Each section shall cure a minimum of 7 days before performing any pushing operation.
4. Sections may be combined or lengthened to facilitate construction upon approval by the Contracting Officer.
5. Alternate construction methods may be used, as approved by the contracting officer.



DUMMY JOINT DETAIL

REINFORCING NOTES
1. All splices shall overlap a minimum of 30 bar diameters.
2. The slab sections in the concrete ramp are not sufficiently reinforced to support themselves.
3. Dimensions for reinforcing bars are to the center of bars.

Figure 4-6 Boat ramp design for wet placement

4-13. Mechanical Boat Launching Devices. Mechanical devices may be substituted for ramps on grade for launching boats up to 25-foot length where steep banks make ramp on grade construction impracticable or to aid the physically handicapped. The selection of mechanical boat launching devices should be guided by manufacture's literature and factory representatives.

4-14. Loading Piers. Only fixed piers which are integral to the launching ramp are covered here. There are many types of fixed piers which function over a varying range of lake levels. The main design problem is to meet the varying water levels. The floating type loading pier is used for more widely varying water levels, greater than 10-15 feet. The fixed pier as discussed here is used for lesser varying pool levels. The fixed pier integral to the launching ramp can be designed with treated wood timbers, concrete cribbing, steel cribbing or a combination of these materials. The pier should be a minimum of 6 feet wide. To meet moderate varying water levels (less than 10 feet) the pier should be alternately ramped (maximum 8.3 percent slope) and flattened to meet the next water level. The number of ramps in the stepping down process will be determined by the lake level fluctuations to be accommodated. Hand railing should be made part of the design to accommodate the physically handicapped. The cribbed area can be filled with rock and gravel and finished with roughened surface concrete. Wind and wave studies should be used to determine the overall design requirements. Figure 4-7 shows an example of the fixed loading pier integral with the boat ramp. Figure 4-8 shows a boat access dock facility for the handicapped.

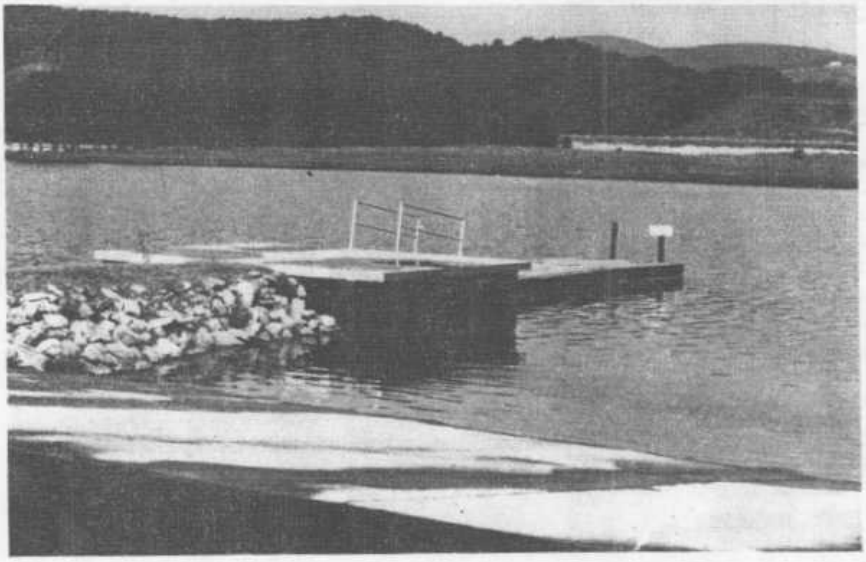


Figure 4-7 Fixed loading pier integral with boat ramp

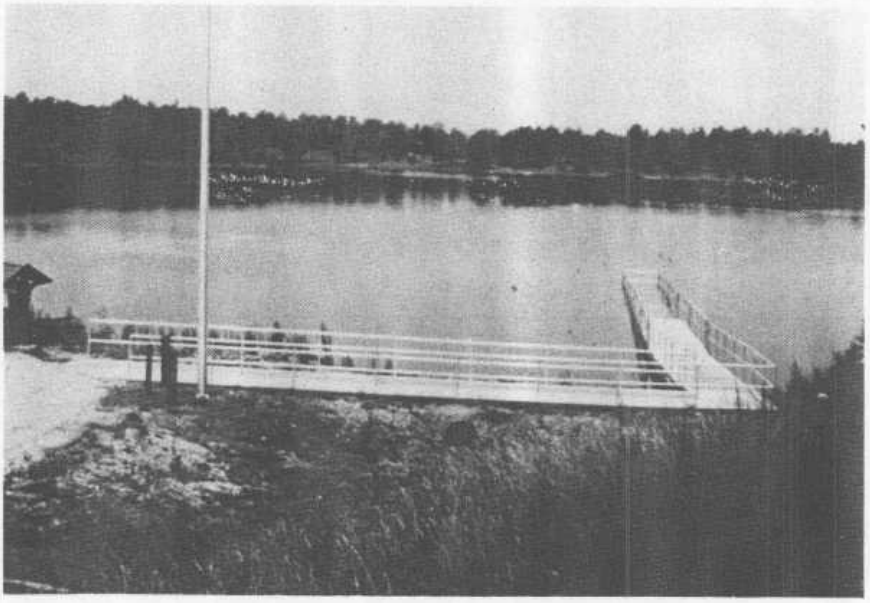


Figure 4-8 Dock facility for the handicapped park user

4-15. Access to Water For Non-Trailered Boats. This paragraph discusses the design of water access facilities for boats placed in the water by hand from the top of a car or trailed object other than a boat trailer. This facility consists of a graded section of shoreline no steeper than 3 on 1 (three horizontal to one verticle), stabilized with rock to withstand erosive forces and accessible from a gravel surfaced road. The grade section and its protection should be designed to meet water levels under the same design standards for ramps as given in paragraph 4-5d(1).